WILDLIFE STRIKES TO CIVIL AIRCRAFT IN THE UNITED STATES 1991-1997

U. S. DEPARTMENT OF TRANSPORTATION

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COVER

While flying his Bell Jet Ranger 206-B at 600 feet AGL, Sgt. Ross Ream, Departmental Pilot, Michigan State Police, encountered this turkey vulture. The bird penetrated just below the squash plate, causing an estimated $9,000 damage, and putting the aircraft out of service for one week. Chief Mechanic Chris Bennett is inspecting the damage. Photo courtesy of Sgt. Ream.

All future reports will feature one or more pictures of aircraft damage resulting from a wildlife strike. Those with quality pictures of wildlife-aircraft strike damage are encouraged to submit them to one of the authors for consideration. Full credit will be given for all pictures used.

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PREFACE

Wildlife strikes to civil aircraft are a serious economic and safety problem in the United States. The Federal Aviation Administration (FAA) has a standard form (FAA Form 5200-7) for the voluntary reporting of bird and other wildlife strikes with aircraft. Although FAA personnel have monitored these reports since 1965 to determine general patterns in wildlife strikes, no quantitative analyses of these data were conducted until 1995.

The FAA, through an interagency agreement with the United States Department of Agriculture's (USDA) National Wildlife Research Center, initiated a project to obtain more objective estimates of the magnitude and nature of the wildlife strike problem nationwide for civil aviation in April, 1995. This project includes 1) editing all strike reports (FAA Form 5200-7) sent to the FAA since 1990 to ensure consistent, error-free data; 2) entering all edited strike reports since 1990 in a Wildlife Strike Database; 3) supplementing FAA-reported strikes with additional, non-duplicated strike reports from other sources; 4) providing FAA with an updated computer file each quarter containing all edited strike reports; and 5) assisting the FAA with the production of annual reports summarizing the results of the analyses. Such analyses are critical to determine the economic cost of wildlife strikes, the magnitude of safety issues, and most importantly, the nature of the problems (e.g., bird species, aircraft and engine types, airports, seasonality, etc.) so that corrective actions can be taken.

The first annual report on wildlife strikes to civil aircraft in the USA, covering 1994, was completed in November 1995 (Dolbeer et al. 1995). A second report, summarizing data for the 3-year period, 1993-1995, was completed in December 1996 (Cleary et al. 1996). A third report, covering the years 1992-1996, was published in August 1997 (Cleary et al. 1997). This is the fourth report. It is the intention of the FAA to publish a detailed report covering the 10-year period, 1990-1999, in the year 2000. Subsequent detailed reports will be produced at 5-year intervals. In the interim years, annual reports summarizing data in tabular and graphic form for all available years will be produced.

WILDLIFE STRIKES TO CIVIL AIRCRAFT IN THE UNITED STATES 1991-1997

SYNOPSIS

This publication presents a synopsis of data on wildlife strikes to United States civil aircraft for the years 1991-1997. Unless noted, all numbers are totals for the 7-year period, and percentages are of the known total. For the 7-year period, 16,949 ($\bar{x}$ = 2,421/year) strikes were reported to the FAA. Between 1991 and 1997 there was a 53% increase in the number of strikes reported annually. Most reports were filed using FAA Form 5200-7 (Table 1). Pilots and tower personnel filed 27% and 17% of the reports, respectively (Table 2). About 74% of the reported strikes involved commercial aircraft; the remainder involved business, private, and miscellaneous aircraft (Table 3).

Reports were received from all 50 States, from some US territories, and from foreign countries when US registered aircraft were involved. Tables 4A and 4B show the distribution of reported bird and mammal strikes for the various states and territories.

Most bird strikes (50%) occurred between July and October (Table 5); 62% occurred during the day (Table 6); 49% occurred when the aircraft was on approach or during the landing roll, and 35% occurred during take-off and climb (Table 7). Fifty-five percent of the bird strikes occurred when the aircraft was at an altitude of less than 100 ft. above ground level (AGL), 78% occurred under 900 ft. AGL, and 87% occurred under 2,000 ft. AGL (Table 8).

Most mammal strikes (44%) occurred in the fall (Table 5); 56% occurred at night (Table 6); 53% occurred when the aircraft was on approach or landing; and 30% occurred during take-off. Nine percent of the reported mammal strikes occurred while the aircraft was still in the air, when the aircraft struck deer with the landing gear or encountered bats (Table 7).

The fixed-wing aircraft types most often involved in strikes that had a negative effect-on-flight were Boeing-737, McDonnell-Douglas MD-80/DC-9, British Aerospace-31, and Cessna 172 (Table 9A). The aircraft types most often involved in a strike that damaged one or more aircraft components and/or caused a loss of time and/or money were Boeing-737, McDonnell-Douglas MD-80/DC-9, British Aerospace-31, and Boeing-727 (Table 9B).

It is worth noting that the MD-80/DC-9 and Boeing-727, while recording among the high percentages of total flight hours for US air carrier aircraft, and comprising a significant portion of the US air carrier fleet, were not involved in a proportionally high number of strikes having an adverse effect-on-flight and/or the aircraft (Tables 9A, 9B).

The aircraft components most commonly reported as struck by birds were windshield, engine, nose, and wing/rotor. Those components most often reported as damaged were engine, wing/rotor, radome, and windshield (Table 10A). Aircraft components most commonly reported as struck by mammals were landing gear, propeller, other, wing/rotor, and engine. These same components ranked highest for the parts most often reported as damaged (Table 10B).

Twelve and 43% of the bird and mammal strike reports, respectively, indicated the strike had an adverse effect on the flight (Table 11).

Birds were involved in 97% of the reported strikes, mammals in 3%, and <1% involved reptiles. Gulls, blackbirds, raptors, waterfowl, and doves were the most commonly struck bird groups (Table 12A). The most commonly struck mammals were deer and coyotes (Table 12B). Gulls were involved in 2.6 times as many strikes as waterfowl, but both groups were involved in essentially the same number of damaging strikes (Table 13).

For the 7-year period, 2,676 reports indicated the strike damaged one or more aircraft components (Table 13); and 2,045 reports indicated the strike had a negative effect on the flight (Table 14).

Reported losses from bird strikes totaled 77,762 hours of aircraft down time (Table 15) and $47.91 million in monetary losses (Table-16); while reported losses from mammal strikes totaled 58,273 hours of aircraft down time (Table 15) and $2.27 million in monetary losses (Table 16), during the 7-year period.

Of the 3,701 reports that indicated the strike had an adverse effect on the aircraft and/or flight, 717 provided an estimate of the aircraft down time (Σ = 136,035 hours, $\bar{x}$ = 190 hours/report), and 558 provided an estimate of the direct and/or other cost (Σ = $50,177,526 $\bar{x}$ = $7,168,218). Of the 558 reports providing a damage cost estimate, 493 gave an estimate of direct aircraft damage (Σ = $44,277,686 $\bar{x}$ = $89,813/report), and 202 gave an estimate of other monetary losses (Σ = $5,899,840 $\bar{x}$ = $29,207/report) (Table 17).

Analysis of strike reports from three major US airports showed that less than 20% of all strikes occurring at these airports were reported to the FAA (Cleary et al. 1996, 1997; Dolbeer et al. 1995). Additionally, many reports received by the FAA were filed before aircraft damage had been fully assessed. For these reasons, the information on the number of strikes and their associated costs compiled from the voluntary reporting program is believed to underestimate the magnitude of the problem.

Assuming all 3,701 reported wildlife-aircraft strikes that had an adverse effect on the aircraft and/or flight engendered similar amounts of down time and/or monetary losses, and that these reports are all of the damaging strikes that occurred, then at a minimum, wildlife-aircraft strikes cost the US civil aviation industry 100,312 hours/year of aircraft down time, $47.49 million/year in direct monetary losses, and $15.44 million/year in associated costs.

Further, assuming a 20% reporting rate, the cost of wildlife-aircraft strikes to the US civil aviation industry is estimated to be in excess of 501,560 hours/year of aircraft down time, $237.43 million/year in direct monetary losses and $77.21 million/year in associated costs.

With the analysis of 7 years of strike data, the magnitude and severity of the wildlife-aircraft strike problem is becoming more

obvious. Two important points need to be made. First, airport managers need to be aware of the wildlife hazards on their airports and take appropriate actions, under the guidance of professional biologists trained in wildlife damage management, to minimize the problems. Second, the focus of airport wildlife management needs to be widened to consider habitats and land-uses in proximity to the airport, such as wetlands, waste-disposal facilities, and wildlife refuges that can attract wildlife hazardous to aviation. Such land uses and activities are often incompatible with aviation safety and should be prohibited near airports or designed and operated in a manner that minimizes the attraction of hazardous wildlife.

Finally, there is a need for increased and more detailed reporting of wildlife strikes. For example, our previous analysis indicated <20% of all wildlife strikes involving US civil aircraft are reported. Furthermore, 52% of all reported bird strikes, 1991-1997, provided no information on the species struck and 79% of strike reports indicating damage provided no estimates of cost. To improve the ease of reporting, strikes can now be reported via the Internet (http://www.faa.gov.arp/birdstrike), in addition to the traditional means of filling out and mailing FAA Form 5200-7. Bird strike remains that can not be identified by airport personnel can often be identified by a local biologist or by sending feather remains to Bird Strike – USDA, 6100 Columbus Ave. Sandusky, OH 44870.

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Table 1. Source of information for reported wildlife strikes to civil aircraft, USA, 1991-1997.

	Number of reported strikes									
	Years									
Source	1991	1992	1993	1994	1995	1996	1997	Total	7-yr. avg.	% of total
FAA Form 5200-7	1,863	1,900	1,799	1,834	1,844	1,771	2,251	13,262	1,895	78
Multiple	82	129	145	180	199	351	315	1,401	200	8
Airport Report	18	23	104	62	117	126	144	594	85	4
AC Incident Report	44	86	106	77	65	75	55	508	73	3
Other	43	41	36	40	82	109	73	424	61	3
PACIR[1]	0	3	11	22	76	72	74	258	37	2
Airline Report	0	0	0	1	0	1	225	227	32	1
Engine Mfg.	1	1	1	1	63	56	0	123	18	1
ASRS[2]	1	14	15	17	16	7	1	71	10	<1
AAIPN[3]	0	11	17	5	5	4	7	49	7	<1
NTSB[4]	6	3	2	2	3	3	0	19	3	<1
Daily Alert Bull	1	4	3	1	0	0	0	9	1	<1
Unknown	1	3	0	0	0	0	0	4	1	<1
Total	2,060	2,218	2,239	2,242	2,470	2,575	3,145	16,949	2,421	100

[1] Preliminary Aircraft Incident Report
[2] Aviation Safety Reporting System
[3] Alano Aircraft Incident Preliminary Notice
[4] National Transportation Safety Board

Table 2. Person filing report of wildlife strike to civil aircraft, USA, 1991-1997.

	Number of reported strikes									
	Years									
Person filing report	1991	1992	1993	1994	1995	1996	1997	Total	7-yr. avg.	% of total
Pilot	684	649	609	564	513	635	838	4,492	642	27
Tower	320	383	420	389	411	500	493	2,916	417	17
Unknown	351	6	262	9	11	849	958	2,446	349	14
Carcass found	21	64	121	60	141	157	250	814	116	5
Airport operations	47	1	40	1	3	228	172	492	70	3
Airline operations	0	0	46	2	0	79	306	433	62	3
Operations	46	24	27	54	45	0	47	243	35	1
Aircraft maintenance	3	10	0	12	6	0	5	36	5	<1
Other [1]	588	1,081	714	1,151	1,340	127	76	5,077	725	30
Total	2,060	2,218	2,239	2,242	2,470	2,575	3,145	16,949	2,421	100

[1] The values in the “Other” category are misleading. Prior to 1996, when multiple reports of a single incident were received, the strike was entered in the “Other” category. The records are currently being edited to correct this situation. In the future, multiple reports of a single incident will be prioritized by pilot, tower, airport operations, or airline operations, and entered in the appropriate category.

Table 3. Number of reported wildlife strikes to civil aircraft by type of operator, USA, 1991-1997.

	Number of reported strikes									
	Years									
Type of operator	1991	1992	1993	1994	1995	1996	1997	Total	7-yr. avg.	% of total
Commercial	1,560	1,661	1,644	1,696	1,823	1,863	2,347	12,594	1,799	74
Business	273	283	254	293	329	392	362	2,186	312	13
Private	89	121	152	139	119	99	74	793	113	5
Government/Police	8	9	5	11	11	6	14	64	9	<1
Unknown	130	144	184	103	188	215	348	1,312	187	8
Total	2,060	2,218	2,239	2,242	2,470	2,575	3,145	16,949	2,421	100

Table 4A. Number of reported bird strikes to civil aircraft by US State, including, Puerto Rico (PR) and the US Virgin Islands (VI), 1991-1997.

	Number of reported strikes									
	Years									
State	1991	1992	1993	1994	1995	1996	1997	Total	7-yr. avg.	% of total
AK	22	21	10	17	22	19	39	150	21	1
AL	28	22	21	59	30	30	41	231	33	1
AR	12	20	10	14	16	11	13	96	14	1
AZ	5	5	12	14	17	31	22	106	15	1
CA	161	189	208	224	256	216	282	1,536	219	9
CO	13	19	19	20	18	25	76	190	27	1
CT	58	43	23	33	29	38	25	249	36	2
DC	44	43	46	61	63	86	103	446	64	3
DE	1	1	1	6	1	1	2	13	2	<1
FL	167	146	142	169	218	205	214	1,261	180	8
GA	55	47	28	66	49	51	46	342	49	2
HI	54	41	24	17	35	92	97	360	51	2
IA	15	22	23	20	24	14	19	137	20	1
ID	1	4	2	5	10	6	9	37	5	<1
IL	57	97	174	124	146	156	141	895	128	5
IN	19	23	23	18	30	15	37	165	24	1
KS	4	6	10	8	11	8	7	54	8	<1
KY	45	65	76	66	54	56	112	474	68	3
LA	52	63	70	48	71	69	46	419	60	3
MA	45	32	41	27	29	30	44	248	35	2
MD	24	31	26	29	33	28	31	202	29	1
ME	7	15	10	6	16	9	14	77	11	<1
MI	59	50	53	40	33	43	51	329	47	2
MN	22	18	25	27	13	15	31	151	22	1
MO	34	32	43	34	50	51	43	287	41	2
MS	13	7	14	11	6	15	11	77	11	<1
MT	0	7	6	2	5	2	4	26	4	<1
NC	55	61	47	72	73	49	68	425	61	3
ND	7	0	3	8	8	4	6	36	5	<1
NE	22	26	27	34	25	17	32	183	26	1
NH	6	4	9	14	8	6	9	56	8	<1
NJ	64	74	75	80	87	82	59	521	74	3
NM	4	4	3	4	10	6	7	38	5	<1
NV	10	5	2	9	11	14	22	73	10	<1
NY	137	148	149	131	139	180	210	1,094	156	7
OH	37	58	81	76	84	94	95	525	75	3
OK	10	15	14	11	9	10	54	123	18	1
OR	10	22	27	20	25	31	73	208	30	1
PA	96	119	102	107	122	111	142	799	114	5
PR	6	2	4	0	5	8	3	28	4	<1
RI	8	8	7	9	6	2	4	44	6	<1
SC	11	11	12	12	15	14	12	87	12	1
SD	3	3	0	4	5	3	5	23	3	<1
TN	71	80	62	45	54	62	79	453	65	3
TX	230	211	194	179	158	175	227	1,374	196	8
UT	4	32	32	25	21	24	35	173	25	1
VA	68	55	42	53	56	56	38	368	53	2
VI	1	3	4	5	8	4	0	25	4	<1
VT	3	2	1	2	2	1	2	13	2	<1
WA	23	20	57	41	46	64	59	310	44	2
WI	23	42	22	13	26	22	36	184	26	1
WV	8	14	10	10	10	8	4	64	9	<1
WY	0	3	0	2	0	1	2	8	1	<1
US Total	1,934	2,091	2,126	2,131	2,298	2,370	2,843	15,793	2,256	96
Foreign/unk.	90	71	58	38	94	115	218	684	98	4
All reports	2,024	2,162	2,184	2,169	2,392	2,485	3,061	16,477	2,354	100

Table 4B. Number of reported mammal strikes to civil aircraft by US State, including Puerto Rico (PR) and the US Virgin Islands (VI), 1991-1997.

	Number of reported strikes									
	Years									
State	1991	1992	1993	1994	1995	1996	1997	Total	7-yr. avg.	% of total
AK	0	0	0	0	2	0	1	3	<1	1
AL	0	1	1	0	0	1	0	3	<1	1
AR	0	0	0	2	2	5	1	10	1	2
AZ	1	2	2	1	1	2	3	12	2	3
CA	2	2	0	1	4	2	2	13	2	3
CO	1	0	0	1	2	1	0	5	1	1
CT	3	2	2	0	2	2	0	11	2	2
DC	4	0	0	0	1	6	3	14	2	3
DE	1	0	0	1	0	0	0	2	<1	<1
FL	0	0	0	2	2	5	5	14	2	3
GA	1	1	2	1	1	0	2	8	1	2
HI	0	1	0	0	0	0	0	1	<1	<1
IA	0	0	2	0	0	0	1	3	<1	1
ID	2	1	0	0	0	1	0	4	1	1
IL	0	3	9	3	9	7	6	37	5	8
IN	0	1	0	2	1	0	0	4	1	1
KS	1	0	0	0	0	0	1	2	<1	<1
KY	0	1	0	0	1	0	0	2	<1	<1
LA	0	0	0	0	0	2	1	3	<1	1
MA	0	2	0	0	0	3	0	5	1	1
MD	2	0	0	2	4	3	1	12	2	3
ME	0	1	0	0	1	0	2	4	1	1
MI	0	2	1	8	2	3	3	19	3	4
MN	1	2	0	0	0	2	1	6	1	1
MO	1	1	1	3	1	0	2	9	1	2
MS	0	0	0	1	0	1	0	2	<1	<1
MT	0	0	0	0	1	0	0	1	<1	<1
NC	0	1	0	4	1	3	1	10	1	2
ND	0	0	0	0	0	0	0	0	0	0
NE	0	2	1	0	0	1	0	4	1	1
NH	1	0	0	2	1	0	0	4	1	1
NJ	2	3	3	6	1	6	4	25	4	6
NM	0	0	0	0	0	1	0	1	<1	<1
NV	3	0	4	0	1	1	0	9	1	2
NY	0	5	0	7	7	3	2	24	3	5
OH	0	3	2	1	2	1	2	11	2	2
OK	0	0	1	1	0	0	4	6	1	1
OR	2	0	0	0	1	1	2	6	1	1
PA	4	7	7	8	6	2	0	34	5	8
PR	0	0	0	0	0	0	0	0	0	0
RI	1	0	1	0	0	0	0	2	<1	<1
SC	0	0	0	0	0	1	1	2	<1	<1
SD	0	0	2	0	0	0	1	3	<1	1
TN	0	0	0	0	1	2	1	4	1	1
TX	1	3	6	4	5	4	3	26	4	6
UT	0	0	1	0	0	0	3	4	1	1
VA	1	0	1	0	4	5	5	16	2	4
VI	0	0	0	0	0	0	0	0	0	0
VT	0	0	0	0	0	0	0	0	0	0
WA	0	0	0	0	1	1	1	3	<1	1
WI	0	1	1	4	0	2	1	9	1	2
WV	1	6	3	5	2	7	4	28	<1	<1
WY	0	0	1	1	0	0	0	2	<1	<1
US total	36	54	54	71	70	87	70	442	63	99
Foreign/unk.	0	1	1	1	0	1	0	4	1	1
All reports	36	55	55	72	70	88	70	446	64	100

Table 5. Number of reported wildlife strikes to civil aircraft by month, USA, 1991-1997. See also Figures 1 and 2.

	Number of reported strikes									
	Years									
Month	1991	1992	1993	1994	1995	1996	1997	Total	7-yr. avg.	% of total
Birds										
Jan.	93	75	95	87	99	108	128	685	98	4
Feb.	79	83	94	75	73	95	119	618	88	4
Mar.	136	110	132	123	159	125	202	987	141	6
Apr.	145	127	183	147	153	158	223	1,136	162	7
May	188	206	196	172	221	227	265	1,475	211	9
Jun.	120	191	158	138	160	167	229	1,163	166	7
Jul.	194	222	226	227	251	252	284	1,656	237	10
Aug.	238	353	289	303	303	323	409	2,218	317	13
Sep.	281	298	341	314	291	329	401	2,255	322	14
Oct.	253	242	249	269	332	335	412	2,092	299	13
Nov.	187	153	127	202	218	215	251	1,353	193	8
Dec.	110	99	94	112	132	151	138	836	119	5
Unknown	0	3	0	0	0	0	0	3	1	<1
Total	2,024	2,162	2,184	2,169	2,392	2,485	3,061	16,477	2,354	100
Mammals										
Jan.	2	2	3	2	2	3	3	17	2	4
Feb.	1	1	1	2	2	2	0	9	1	2
Mar.	0	1	1	6	11	4	6	29	4	7
Apr.	0	2	4	1	3	2	4	16	2	4
May	0	3	4	3	0	7	5	22	3	5
Jun.	0	5	8	4	6	11	7	41	6	9
Jul.	7	5	5	6	5	6	7	41	6	9
Aug.	3	3	1	4	6	14	8	39	6	9
Sep.	3	9	7	7	10	9	5	50	7	11
Oct.	4	8	9	13	9	12	10	65	9	15
Nov.	10	12	8	17	10	15	8	80	11	18
Dec.	6	4	4	7	6	3	7	37	5	8
Total	36	55	55	72	70	88	70	446	64	100

Table 6. Reported time of occurrence of wildlife strikes to civil aircraft, USA, 1991-1997. See also Figures 3A, 3B and 4A, 4B.

	Number of reported strikes									
	Years									
Time	1991	1992	1993	1994	1995	1996	1997	Total	7-yr. avg.	% of total
Birds										
Dawn	42	80	82	71	106	114	122	617	88	4
Day	1,321	1,408	1,376	1,406	1,463	1,481	1,720	10,175	1,454	62
Dusk	73	86	123	138	113	126	148	807	115	5
Night	503	536	517	486	565	548	750	3,905	558	24
Unknown	85	52	86	68	145	216	321	973	139	5
Total	2,024	2,162	2,184	2,169	2,392	2,485	3,061	16,477	2,354	100
Mammals										
Dawn	1	2	2	0	1	1	1	8	1	2
Day	6	9	21	9	16	23	14	98	14	22
Dusk	5	10	2	5	6	9	5	42	6	9
Night	22	30	25	50	35	45	41	248	35	56
Unknown	2	4	5	8	12	10	9	50	7	11
Total	36	55	55	72	70	88	70	446	64	100

Table 7. Reported phase of flight at time of wildlife strikes to civil aircraft, USA, 1991-1997.

	Number of reported strikes									
	Years									
Phase of flight	1991	1992	1993	1994	1995	1996	1997	Total	7-yr. avg.	% of total
Birds										
Taxiing	5	10	8	9	12	9	7	60	9	<1
Take-off	376	366	516	454	449	454	495	3,110	444	19
Climb	366	370	233	349	403	413	516	2,650	379	16
En Route	68	78	76	72	81	78	102	555	79	3
Descent	70	73	66	65	92	81	101	548	78	3
Approach	758	810	768	715	777	800	1,011	5,639	806	34
Landing roll	307	351	344	399	347	382	397	2,527	361	15
Parked	0	3	0	1	3	1	1	9	1	<1
Not Reported	74	101	173	105	228	267	431	1,379	197	8
Total	2,024	2,162	2,184	2,169	2,392	2,485	3,061	16,477	2,354	100
Mammals										
Taxiing	2	1	0	0	0	0	1	4	1	1
Take-off	12	16	12	28	22	23	22	135	19	30
Climb	4	0	0	0	0	2	1	7	1	2
En Route	0	0	0	1	0	0	0	1	<1	<1
Descent	0	1	0	0	0	0	0	1	<1	<1
Approach	4	4	9	2	7	5	2	33	5	7
Landing roll	12	30	25	37	30	41	31	206	29	46
Parked	0	0	0	0	0	0	0	0	0	0
Not Reported	2	3	9	4	11	17	13	59	8	13
Total	36	55	55	72	70	88	70	446	64	100

Table 8. Number of reported bird strikes to civil aircraft by altitude (feet) above ground level (AGL), USA, 1991-1997. See also Figure 5.

Altitude of strike[1] (feet AGL)			Number of reported strikes: Years 1991	1992	1993	1994	1995	1996	1997	Total	7-yr. avg.	% of known	Cum. % of total
0	To	0	688	727	675	818	723	833	897	5,361	766	39	39.1
1	To	99	294	341	305	272	307	292	338	2,149	307	16	54.8
100	To	199	139	130	127	140	133	126	160	955	136	7	61.8
200	To	299	80	94	94	94	102	69	93	626	89	5	66.4
300	To	399	60	76	53	65	68	59	63	444	63	3	69.6
400	To	499	38	23	49	29	36	37	43	255	36	2	71.5
500	To	599	76	61	61	57	60	73	79	467	67	3	74.9
600	To	699	25	22	23	18	17	20	17	142	20	1	75.9
700	To	799	15	15	14	16	13	19	18	110	16	1	76.7
800	To	899	25	36	19	33	25	32	36	206	29	2	78.2
900	To	999	16	8	11	4	14	7	22	82	12	1	78.8
1,000	To	1,499	100	103	97	98	96	97	106	697	100	5	83.9
1,500	To	1,999	61	65	67	53	64	55	84	449	64	3	87.2
2,000	To	2,999	74	80	70	65	74	94	93	550	79	4	91.2
3,000	To	3,999	60	45	50	40	61	59	76	391	56	3	94.0
4,000	To	4,999	31	20	26	25	47	30	52	231	33	2	95.7
5,000	To	5,999	19	22	24	29	19	31	25	169	24	1	97.0
6,000	To	6,999	20	17	22	16	14	9	22	120	17	1	97.8
7,000	To	7,999	11	14	8	7	15	12	20	87	12	1	98.5
8,000	To	8,999	3	8	8	3	9	10	7	48	7	<1	98.8
9,000	To	9,999	2	4	3	6	2	6	8	31	4	<1	99.1
10,000	To	14,999	18	18	10	10	11	18	21	106	15	1	99.8
15,000	To	19,999	8	2	2	0	1	0	0	13	2	<1	99.9
20,000	To	29,999	0	0	0	0	2	2	1	5	1	<1	100.0
30,000	To	39,000	4	1	0	0	1	0	0	6	1	<1	100.0
Total known			1,867	1,932	1,818	1,898	1,914	1,990	2,281	13,700	1,957		
Unknown			157	230	366	271	478	495	780	2,777	397		
Grand total			2,024	2,162	2,184	2,169	2,392	2,485	3,061	16,477	2,354		

[1] On October 23, 1991, a DC-8-62 struck a “blue bird with red feet” at 39,000 feet. This is the highest reported altitude for a bird strike in the USA.

Table 9A. Number of reported strikes that had a negative effect on the flight for the 24 most commonly involved fixed-wing aircraft types, USA, 1991-1997.

		Number of reported strikes									% of total		
		Years											
Aircraft	Engine[1]	1991	1992	1993	1994	1994	1996	1997	Total	7-yr avg.	Strikes	Flight time[2]	US fleet[3]
B-737	TF/TJ	30	36	41	60	57	75	74	373	53	20	18	15
MD-80/DC-9	TF	9	15	16	30	36	33	27	166	24	9	18	16
BA-31	TP	10	14	10	19	15	15	10	93	13	5	3	3
C-172[4]	PS	7	12	7	14	7	8	7	62	9	3	-	-
SAAB-340	TP	5	7	6	10	9	11	7	55	8	3	3	3
PA-28[4]	PS	4	4	5	11	8	9	13	54	8	3	-	<1
B-727	TJ	5	5	10	9	4	11	9	53	8	3	12	14
B-757	TF	1	8	7	12	11	3	10	52	7	3	7	6
BE-1900	TP	4	3	7	4	12	10	7	47	7	2	3	4
Learjet	TJ	6	4	5	5	8	8	7	43	6	2	<1	<1
B-747	TF	3	4	6	5	10	8	2	38	5	2	4	3
Citation[4]	TF	6	6	3	8	7	4	4	38	5	2	-	-
ATR-42/72	TP	4	3	3	3	7	4	8	32	5	2	<1	-
C-152	PS	5	3	3	3	5	5	8	32	5	2	-	-
DASH 8	TP	0	3	2	4	7	4	10	30	4	2	2	2
EMB-120	TP	3	0	2	6	3	5	5	24	3	1	3	3
FK-100	TF	0	3	3	7	4	3	2	22	3	1	0	0
BE-55	PS	1	1	5	6	4	0	3	20	3	1	0	0
C-150[4]	PS	3	0	1	4	7	2	3	20	3	1	-	-
B-767	TF	2	2	3	2	5	5	0	19	3	1	4	3
BE-35[4]	PS	1	3	1	1	5	7	1	19	3	1	-	-
C-310	PS	0	2	2	2	5	5	3	19	3	1	0	<1
BE-200	TP	2	1	0	0	3	4	5	15	2	1	<1	<1
A-300	TF	3	1	2	4	1	1	2	14	2	1	1	1
Total		114	140	150	229	240	240	227	1,340	191	70	79	73
Unk./other		45	73	59	86	102	100	106	571	82	30	21	27
Grand Total		159	213	209	315	342	340	333	1,911	273	100	100	100

[1] TF = Turbo-fan, TJ = Turbo-jet, TP = Turbo-prop, PS = Piston.

[2] Percentage of the total flight hours for US civil air carrier aircraft by aircraft type, reported to be in operation by US commercial air carriers, 1991-1996 (Stamas 1997: Table 5.2). Data for 1997 was not available as of this writing.

[3] The number of aircraft is the monthly average reported in use for the last three months of the year, 1991-1996 (Stamas 1997: Table 5.3). Data for 1997 was not available as of this writing.

[4] Non air carrier aircraft. Air carrier aircraft carry passengers or cargo for hire under 14 CFR 121 (large aircraft - more than 30 seats) and 14 CFR 135 (small aircraft - 30 seats or less).

Table 9B. Number of reported strikes that damaged an aircraft component or resulted in lost time or money for the 24 most commonly involved fixed-wing aircraft types, USA, 1991-1997.

		Number of reported strikes											
		Years									% of total		
Aircraft	Engine[1]	1991	1992	1993	1994	1995	1996	1997	Total	7-yr. avg.	Strikes	Flight time[2]	US fleet[3]
B-737	TF/TJ	59	52	61	76	101	130	108	587	84	20	18	15
MD-80/DC-9	TF	28	30	31	41	48	38	52	268	38	9	18	16
BA-31	TP	16	26	20	22	14	13	14	125	18	4	3	3
B-727	TJ	17	12	14	15	16	16	18	108	15	4	12	14
B-757	TF	5	9	15	12	24	16	21	102	15	4	7	6
BE-1900	TP	2	8	12	9	13	14	26	84	12	3	3	4
C-172[4]	PS	12	16	11	15	12	13	4	83	12	3	-	-
PA-28[4]	PS	13	9	10	9	6	15	14	76	11	3	-	<1
B-747	TF	7	6	14	6	13	12	10	68	10	2	4	3
Citation[4]	TF	9	8	5	12	15	5	8	62	9	2	-	-
Learjet	TJ	12	8	7	7	8	10	6	58	8	2	<1	<1
SAAB-340	TP	3	6	4	7	9	11	9	49	7	2	3	3
B-767	TF	8	1	7	2	9	12	8	47	7	2	5	3
FK-100	TF	1	1	4	6	8	9	14	43	6	1	0	0
BE-55	PS	3	3	9	7	4	3	6	35	5	1	<1	0
C-152[4]	PS	6	6	3	2	9	4	4	34	5	1	-	-
ATR-42	TP	7	5	6	6	4	2	1	31	4	1	<1	-
C-310	PS	3	3	3	4	8	6	4	31	4	1	<1	<1
EMB-120	TP	3	2	6	7	2	4	7	31	4	1	3	3
BE-35[4]	PS	3	3	6	4	5	6	3	30	4	1	-	-
C-182[4]	PS	2	2	3	5	3	7	7	29	4	1	-	-
PA-31	PS	3	3	5	3	4	5	6	29	4	1	<1	1
A-320	TF	2	0	2	4	6	4	9	27	4	1	<1	1
DASH 8	TP	1	2	1	3	4	7	9	27	4	1	2	2
Total		225	221	259	284	345	362	368	2,064	295	71	79	75
Unk./other		103	106	111	114	129	136	137	836	119	29	21	25
Grand total		328	327	370	398	474	498	505	2,900	414	100	100	100

[1] TF = Turbo-fan, TJ = Turbo-jet, TP = Turbo-prop, PS = Piston.

[2] Percentage of the total flight hours for US civil air carrier aircraft, by aircraft type, reported to be in operation by US commercial air carriers, 1991-1996, (Stamas 1997: Table 5.2). Data for 1997 was not available as of this writing.

[3] The number of aircraft is the monthly average reported in use for the last three months of the year, 1991-1996, (Stamas 1997: Table 5.3). Data for 1997 was not available as of this writing.

[4] Non air carrier aircraft. Air carrier aircraft carry passengers or cargo for hire under 14 CFR 121 (large aircraft - more than 30 seats) and 14 CFR 135 (small Aircraft - 30 seats or less).

Table 10A. Civil aircraft components reported as being struck and/or damaged by birds, USA, 1991-1997.

	Number of reported strikes								
	Years								
Parts of aircraft	1991	1992	1993	1994	1995	1996	1997	Total	7-yr. avg.
Windshield									
Struck	269	345	365	405	402	403	584	2,773	396
Damaged	22	28	25	38	42	31	40	226	32
Engine									
Struck	227	267	260	297	390	377	428	2,246	321
Damaged	106	100	120	123	152	180	140	921	132
Nose									
Struck	191	225	253	265	306	300	444	1,984	283
Damaged	24	17	26	19	18	30	34	168	24
Wing/rotor									
Struck	219	244	249	258	312	284	353	1,919	274
Damaged	85	83	88	91	110	81	98	636	91
Radome									
Struck	160	196	201	226	255	238	385	1,661	237
Damaged	39	24	25	41	47	35	56	267	38
Fuselage									
Struck	171	224	215	230	222	257	328	1,647	235
Damaged	14	12	10	10	9	17	19	91	13
Landing Gear									
Struck	79	104	92	123	127	114	168	807	115
Damaged	9	16	10	15	17	14	25	106	15
Propeller									
Struck	50	86	75	84	98	74	98	565	81
Damaged	5	7	13	9	7	8	16	65	9
Other									
Struck	25	58	81	90	112	68	73	507	72
Damaged	20	24	37	41	49	30	38	239	34
Tail									
Struck	21	26	26	27	38	41	37	216	31
Damaged	12	10	13	13	15	18	18	99	14
Light									
Struck	15	11	23	18	18	16	36	137	20
Damaged	11	8	21	15	16	12	29	112	16
Total parts struck	1,427	1,786	1,840	2,023	2,280	2,172	2,934	14,462	2,066
Total parts damaged	347	329	388	415	482	456	513	2,930	419

Table 10B. Civil aircraft components reported as being struck and/or damaged by mammals, USA, 1991-1997.

	Number of reported strikes								
	Years								
Parts of aircraft	1991	1992	1993	1994	1995	1996	1997	Total	7-yr. avg.
Landing Gear									
Struck	11	11	15	28	23	21	29	138	20
Damaged	7	11	11	15	16	19	20	99	14
Propeller									
Struck	3	6	2	13	11	18	10	63	9
Damaged	3	5	3	13	7	18	7	56	8
Other									
Struck	4	3	10	18	5	10	2	52	7
Damaged	5	3	10	15	5	11	2	51	7
Wing/rotor									
Struck	3	3	4	11	8	12	9	50	7
Damaged	1	3	3	12	8	14	9	50	7
Engine									
Struck	3	3	2	8	5	8	5	34	5
Damaged	5	3	2	7	4	6	6	33	5
Fuselage									
Struck	0	1	3	8	6	5	4	27	4
Damaged	0	0	3	7	6	6	5	27	4
Nose									
Struck	0	1	3	3	4	2	6	19	3
Damaged	0	1	3	3	3	2	5	17	2
Tail									
Struck	0	5	0	3	2	6	1	17	2
Damaged	0	5	1	4	1	7	1	19	3
Light									
Struck	0	0	2	2	0	1	1	6	1
Damaged	0	0	1	2	0	1	1	5	1
Radome									
Struck	0	0	0	2	1	0	1	4	1
Damaged	0	0	0	2	0	0	2	4	1
Windshield									
Struck	0	1	0	1	2	0	0	4	1
Damaged	0	0	1	1	1	0	0	3	<1
Total parts struck	24	34	41	97	67	83	68	414	59
Total parts damaged	21	31	38	81	51	84	58	364	52

Table 11. Reported effect-on-flight of wildlife strikes to civil aircraft, USA, 1991-1997.

	Number of reported strikes									
	Years									
Effect on flight	1991	1992	1993	1994	1995	1996	1997	Total	7-yr. avg.	% of total
Birds										
None	853	1,444	1,525	1,707	1,760	1,487	1,853	10,629	1,518	65
Precautionary landing	69	85	121	109	124	165	160	833	119	5
Other	25	38	141	93	105	42	53	497	71	3
Aborted take-off	44	51	52	64	65	86	80	442	63	3
Engine shut down	11	15	8	12	16	11	12	85	12	1
Not reported	1,022	529	337	184	322	694	903	3,991	570	24
Total	2,024	2,162	2,184	2,169	2,392	2,485	3,061	16,477	2,354	100
Mammals										
None	7	10	11	21	24	14	15	102	15	23
Precautionary landing	2	1	2	5	7	5	3	25	4	6
Other	5	15	18	19	13	20	11	101	14	23
Aborted take-off	5	7	3	12	10	11	9	57	8	13
Engine shut down	0	1	1	0	1	0	1	4	1	1
Not reported	17	21	20	15	15	38	31	157	22	35
Total	36	55	55	72	70	88	70	446	64	100

Table 12A. Identified bird groups commonly involved in reported strikes to civil aircraft, USA, 1991-1997.

	Number of reported strikes									
	Years									
Wildlife group	1991	1992	1993	1994	1995	1996	1997	Total	7-yr. avg.	% of total known
Gulls/Terns	367	367	360	321	317	346	371	2,449	350	31
Gulls	352	351	332	304	296	304	323	2,262	323	29
Herring gulls	9	7	6	3	6	8	23	62	9	1
Laughing gulls	5	3	5	5	4	8	9	39	6	<1
Ring-billed gulls	1	3	13	3	8	22	14	64	9	1
Bonaparte's gull	0	0	2	0	0	0	0	2	<1	<1
Terns	0	3	2	6	3	4	2	20	3	<1
Blackbirds	135	140	147	135	135	146	172	1,010	144	13
Starlings	51	54	56	61	48	64	75	409	58	5
Blackbirds	77	77	82	63	72	64	78	513	73	7
Meadowlarks	7	9	9	11	14	16	17	83	12	1
Myna	0	0	0	0	1	2	2	5	1	<1
Raptors	103	119	114	128	149	145	181	939	134	12
Vultures	27	22	15	23	18	23	23	151	22	2
Eagles	3	2	2	6	4	4	2	23	3	<1
Osprey	3	1	2	2	0	1	6	15	2	<1
Hawks	54	70	71	82	102	83	121	583	83	7
Owls	16	24	24	15	23	33	29	164	23	2
Kites	0	0	0	0	2	1	0	3	<1	<1
Waterfowl	106	107	142	145	139	144	146	929	133	12
Ducks	53	51	67	63	52	66	79	431	62	5
Geese	53	56	75	80	87	77	67	495	71	6
Swans	0	0	0	2	0	1	0	3	<1	<1
Doves	118	107	117	140	112	137	130	861	123	11
Doves	52	45	62	85	42	72	51	409	58	5
Rock doves	62	49	39	38	53	47	49	337	48	4
Mourning doves	4	13	16	17	17	18	30	115	16	1
Sparrows[1]	94	86	88	91	82	84	78	603	86	8
Shorebirds	26	23	21	31	29	38	52	220	31	3
Unk. shorebirds	4	4	1	2	1	4	4	20	3	<1
Pelicans	3	4	1	3	3	2	1	17	2	<1
Cormorants	0	3	1	0	2	5	0	11	2	<1
Plovers	4	2	1	2	3	9	12	33	5	<1
Killdeer	8	8	13	16	17	14	31	107	15	1
Sandpipers	7	2	4	8	3	4	4	32	5	<1
Swallows	17	35	31	23	32	24	52	214	31	3
Swallow	12	15	17	14	23	12	19	112	16	1
Purple martin	2	12	3	3	1	5	4	30	4	<1
Barn swallow	2	7	9	5	4	4	15	46	7	1
Tree swallow	1	1	2	0	4	3	14	25	4	<1
Cliff swallow	0	0	0	1	0	0	0	1	<1	<1

Table 12A. Continued

Wildlife group	Number of reported strikes: Years 1991	1992	1993	1994	1995	1996	1997	Total	7-yr. avg.	% of total known
Wading Birds	30	17	27	21	29	36	38	198	28	3
Herons	7	4	7	7	6	10	15	56	8	1
Egrets	21	10	17	13	16	18	18	113	16	1
Cranes	2	2	3	1	4	8	4	24	3	<1
Loons	0	1	0	0	0	0	0	1	<1	<1
Storks	0	0	0	0	1	0	1	2	<1	<1
Ibises	0	0	0	0	2	0	0	2	<1	<1
Corvids	20	19	24	31	32	15	16	157	22	2
Crows	18	17	21	28	31	14	16	145	21	2
Ravens	1	0	1	1	1	0	0	4	1	<1
Blue jays	1	0	0	0	0	1	0	2	<1	<1
Magpie		2	2	2				6	1	<1
Gallinaceous	8	7	8	3	3	7	8	44	6	1
Turkey	1	1	1	0	0	3	2	8	1	<1
Pheasant	6	3	4	2	2	1	2	20	3	<1
Ptarmigan	0	0	1	0	0	1	0	2	<1	<1
Quail	0	1	0	1	0	1	1	4	1	<1
Hungarian partridge	1	1	0	0	0	0	0	2	<1	<1
Guineafowl	0	0	1	0	0	0	0	1	<1	<1
Grouse	0	1	1	0	1	1	3	7	1	<1
American robin	19	10	12	9	5	8	7	70	10	1
Larks	2	4	4	2	6	3	4	25	4	<1
Misc. birds	6	23	17	21	40	26	34	167	25	2
Total known	1,051	1,064	1,112	1,101	1,110	1,159	1,289	7,886	1,127	100
Unknown	973	1,098	1,072	1,068	1,282	1,326	1,772	8,591	1,227	
Total birds	2,024	2,162	2,184	2,169	2,392	2,485	3,061	16,477	2,354	

[1] Some of the birds identified on strike reports as “sparrows” probably belong to other groups such as snow buntings, finches, juncos, etc.

Table 12B. Identified mammal and reptile groups commonly involved in reported wildlife strikes to civil aircraft, USA, 1991-1997.

	Number of reported strikes									
	Years									
Wildlife group	1991	1992	1993	1994	1995	1996	1997	Total	7-yr. avg.	% of total known
Mammals										
Ungulates	26	46	36	56	39	59	44	307	44	69
Deer	21	28	29	50	32	28	13	201	29	45
White-tailed Deer	5	16	4	5	5	28	26	89	13	20
Mule Deer	0	0	0	0	0	0	1	1	<1	<1
Elk	0	1	2	1	0	2	1	7	1	2
Cattle	0	1	0	0	1	1	0	3	<1	1
Moose	0	0	0	0	1	0	1	2	<1	<1
Pronghorn	0	0	1	0	1	0	1	3	<1	1
Horse	0	0	0	0	0	0	1	1	<1	<1
Carnivores	5	5	6	14	19	24	15	88	13	20
Coyote	3	1	4	10	11	11	8	48	7	11
Dog	0	1	0	1	4	4	0	10	1	2
Fox	2	1	0	2	2	5	3	15	2	3
Raccoon	0	0	2	1	1	0	3	7	1	2
Striped Skunk	0	0	0	0	1	4	1	6	1	1
Domestic Cat	0	2	0	0	0	0	0	2	<1	<1
Chiropteras	3	2	6	1	4	1	1	18	3	4
Bat	3	2	6	1	4	1	1	18	3	4
Rodents	0	1	4	0	6	0	2	13	2	3
Woodchuck	0	1	4	0	5	0	2	12	2	3
Muskrat	0	0	0	0	1	0	0	1	<1	<1
Marsupials	0	0	3	0	1	1	4	9	1	2
Opossum	0	0	3	0	1	1	4	9	1	2
Lagomorphs	1	1	0	0	0	0	1	3	<1	1
Rabbit	1	1	0	0	0	0	1	3	<1	1
Armadillo	0	0	0	0	0	3	2	5	1	1
Peccary	0	0	0	0	0	0	1	1	<1	<1
Unknown	1	0	0	1	0	0	0	2	<1	<1
Total mammals	36	55	55	72	70	88	70	446	64	100
Reptiles										
Turtles	0	1	0	0	6	1	10	18	3	69
Turtle	0	1	0	0	4	0	7	12	2	46
FL soft shell turtle	0	0	0	0	2	0	1	3	<1	12
Box turtle	0	0	0	0	0	1	2	3	<1	12
Alligators	0	0	0	1	2	1	4	8	1	31
Total reptiles	0	1	0	1	8	2	14	26	4	100

Table 13. Number of reported wildlife strikes causing damage to one or more components of a civil aircraft by wildlife group, USA, 1991-1997.

	Number of reported strikes									
	Years									
Wildlife group	1991	1992	1993	1994	1995	1996	1997	Total	7-yr. avg.	% of total known
Birds										
Gulls/terns	53	63	60	58	69	63	70	436	62	32
Waterfowl	52	52	57	64	72	61	64	422	60	31
Raptors	32	28	30	41	29	30	35	225	32	17
Doves	19	7	14	15	16	15	8	94	13	7
Blackbirds	5	4	11	8	8	9	13	58	8	4
Wading birds	6	2	8	4	3	7	10	40	6	3
Shorebirds	5	6	3	4	3	2	6	29	4	2
Corvids	0	2	0	6	4	1	3	16	2	1
Sparrows	2	1	3	4	2	3	1	16	2	1
Gallinaceous	1	2	2	1	0	2	1	9	1	1
Misc. birds	1	1	1	2	2	3	1	11	2	1
Total known	176	168	189	207	208	196	212	1,356	194	100
Unknown	118	108	135	130	204	209	201	1,105	158	
Total birds	294	276	324	337	412	405	413	2,461	352	
Mammals										
Ungulates	12	25	24	38	30	47	31	207	30	97
Carnivores	1	1	0	1	1	1	0	5	1	2
Chiropteras	0	0	0	1	0	0	0	1	<1	<1
Total mammals	13	26	24	40	31	48	31	213	30	100
Reptiles										
Alligators	0	0	0	1	0	0	0	1	<1	50
Turtles	0	0	0	0	1	0	0	1	<1	50
Total reptiles	0	0	0	1	1	0	0	2	<1	100
Grand total	307	302	348	378	444	453	444	2,676	382	

Table 14. Number of reported wildlife strikes having a negative effect-on-flight of a civil aircraft by wildlife group, USA, 1991-1997.

	Number of reported strikes									
	Years									
Wildlife group	1991	1992	1993	1994	1995	1996	1997	Total	7-yr. avg.	% of total known
Birds										
Gulls/terns	35	39	63	51	58	61	54	361	52	35
Waterfowl	23	17	32	40	37	31	25	205	29	20
Raptors	14	20	29	25	18	20	26	152	22	15
Doves	11	12	23	18	17	20	11	112	16	11
Blackbirds	5	6	16	8	17	17	12	81	12	8
Wading birds	3	0	7	5	3	7	10	35	5	3
Sparrows	3	5	5	7	6	2	0	28	4	3
Shorebirds	1	2	5	2	1	3	4	18	3	2
Corvids	1	1	0	4	3	1	3	13	2	1
Gallinaceous	1	3	2	0	0	2	4	12	2	1
Misc. birds	0	1	1	2	5	4	5	18	3	2
Total known	97	106	183	162	165	168	154	1,035	148	100
Unknown	52	83	138	116	144	136	151	820	117	
Total birds	149	189	321	278	309	304	304	1,855	265	
Mammals										
Ungulate	11	23	24	32	26	32	10	158	23	84
Carnivores	1	1	0	3	5	4	2	16	2	9
Rodents	0	0	0	0	1	0	12	13	2	7
Unknown	0	0	0	1	0	0	0	1	0	1
Total mammals	12	24	24	36	32	36	24	188	27	100
Reptiles										
Alligators	0	0	0	1	0	0	0	1	<1	50
Turtles	0	0	0	0	1	0	0	1	<1	50
Total reptiles	0	0	0	1	1	0	0	2	0	100
Grand total	161	213	345	315	342	340	329	2,045	292	

Table 15. Reported aircraft down time (hours) resulting from wildlife strikes to civil aircraft by wildlife group, USA, 1991-1997.

	Reported down time (hours)									
	Years									
Wildlife group	1991	1992	1993	1994	1995	1996	1997	Total	7-yr. avg.	% of total known
Birds										
Waterfowl	1,512	2,940	2,504	2,373	3,038	2,970	6,241	21,578	3,083	34
Raptors	766	1,268	705	4,021	1,394	3,518	6,849	18,521	2,646	29
Gulls/terns	685	290	7,864	517	1,370	783	3,228	14,737	2,105	23
Doves	143	30	12	24	39	110	4,585	4,943	706	8
Wading birds	0	2	1,387	173	49	326	0	1,937	277	3
Blackbirds	0	2	83	739	7	150	13	994	142	2
Shorebirds	0	580	6	97	0	10	51	744	106	1
Corvids	0	0	0	73	3	0	1	77	11	<1
Gallinaceous	1	24	2	0	0	39	1	67	10	<1
Misc. birds	6	17	0	31	4	2	8	68	10	<1
Total known	3,113	5,153	12,563	8,048	5,904	7,908	20,977	63,666	9,095	100
Unknown	1,404	776	2,410	790	1,453	2,745	4,518	14,096	2,014	
Total birds	4,517	5,929	14,973	8,838	7,357	10,653	25,495	77,762	11,109	
Mammals										
Ungulates	12	2,920	3,602	25,668	152	9,251	8,718	50,323	7,189	86
Carnivores	0	0	0	5,760	2,160	6	24	7,950	1,136	14
Total mammals	12	2,920	3,602	31,428	2,312	9,257	8,742	58,273	8,325	100
Grand total	4,529	8,849	18,575	40,266	9,669	19,910	34,237	136,035	19,434	

Table 16. Reported monetary losses (cost of damage, lost revenue, and other monetary losses) in US dollars, resulting from wildlife strikes to civil aircraft by wildlife group, USA, 1991-1997.

	Reported monetary losses (US $)									
	Years									
Wildlife group	1991	1992	1993	1994	1995	1996	1997	Total	7-yr. avg.	% of total known
Birds										
Waterfowl	1,127,389	56,850	65,400	1,453,706	16,445,471	1,177,173	1,004,295	21,330,284	3,047,183	59
Gulls/terns	527,000	905,204	434,762	722,440	718,504	841,776	2,116,263	6,265,949	895,136	17
Raptors	803,000	241,259	447,500	2,175,648	269,763	101,775	34,600	4,073,545	581,935	11
Doves	168,965	155,661	75,100	400	1,509,900	11,000	1,041,600	2,962,626	423,232	8
Wading birds	66,540	1,000	65,000	511,000	0	4,360	0	647,900	92,557	2
Blackbirds	0	200	7,900	163,000	11,000	27,000	238,050	447,150	63,879	1
Misc. birds	5,500	19,020	6,000	362,405	1,050	7,030	51,672	452,677	64,668	1
Total known	2,698,394	1,379,194	1,101,662	5,388,599	18,955,688	2,170,114	4,486,480	36,180,131	5,168,590	100
Unknown	638,775	1,847,200	3,080,279	953,068	1,291,305	2,000,434	1,919,168	11,730,229	1,675,747	
Total birds	3,337,169	3,226,394	4,181,941	6,341,667	20,246,993	4,170,548	6,405,648	47,910,360	6,844,337	
Mammals										
Ungulates	0	6,000	192,250	463,342	153,600	780,976	530,878	2,127,046	303,864	94
Carnivores	0	0	0	105,000	35,000	0	120	140,120	20,017	6
Total mammals	0	6,000	192,250	568,342	188,600	780,976	530,998	2,267,166	323,881	100
Grand total	3,337,169	3,232,394	4,374,191	6,910,009	20,435,593	4,951,524	6,936,646	50,177,526	7,168,218	

Table 17. Number of reported wildlife strikes and reported losses by category of effect and category of losses to civil aircraft, USA, 1991-1997.

Year		Adverse effect from strike	Strike effected flight	Strike damaged aircraft component	Lost time (hours)	Cost (US $)		
						Total	Direct	Other
1991	Number of reports	393	161	307	60	56	50	23
	Losses reported				4,529	$3,337,169	$2,570,284	$766,885
1992	Number of reports	431	213	302	78	63	49	29
	Losses reported				8,849	$3,232,394	$3,150,627	$81,767
1993	Number of reports	479	345	348	67	62	56	21
	Losses reported				18,575	$4,374,191	$4,268,844	$105,347
1994	Number of reports	511	315	378	103	84	77	25
	Losses reported				40,266	$6,910,009	$5,311,314	$1,598,695
1995	Number of reports	613	342	444	93	75	64	29
	Losses reported				9,669	$20,435,593	$18,933,889	$1,501,704
1996	Number of reports	626	340	453	143	96	86	35
	Losses reported				19,910	$4,951,524	$4,327,631	$623,893
1997	Number of reports	648	329	444	173	122	111	40
	Losses reported				34,237	$6,936,646	$5,715,097	$1,221,549
Total	Number of reports	3,701	2,045	2,676	717	558	493	202
	Losses reported				136,035	$50,177,526	$44,277,686	$5,899,840
7-yr. avg.	Number of reports	529	292	382	102	80	70	29
	Losses reported				19,434	$7,168,218	$6,325,384	$842,834
Average loss per incident					190	$119,020	$89,813	$29,207
Estimated annual losses								
	Minimum[1]				100,312	$62,927,510	$47,485,284	$15,442,226
	Maximum[2]				501,560	$314,637,552	$237,426,421	$77,211,131

[1] Minimum values are based on the assumption that all 3,701 reported strikes having an adverse effect on the flight and/or aircraft engendered similar amounts of damage and/or down time, and that these reports are all of the damaging strikes that occurred.

[2] Maximum values are based on the assumption that the 3,701 reported strikes having an adverse effect represent 20% of the total.

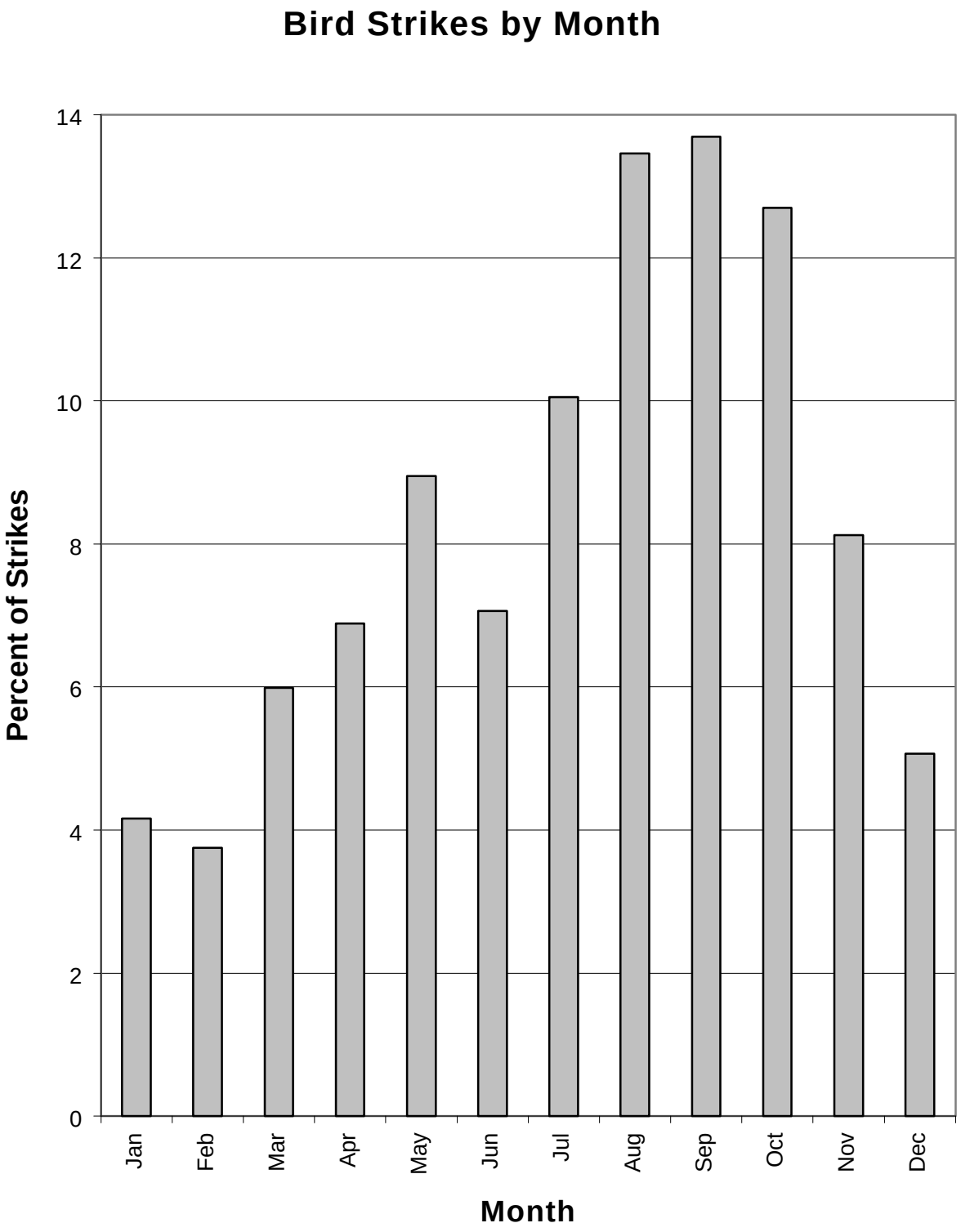

Figure 1. Percentage of reported bird strikes to civil aircraft by month, USA, 1991-1997 (n = 16,474). See also Table 5.

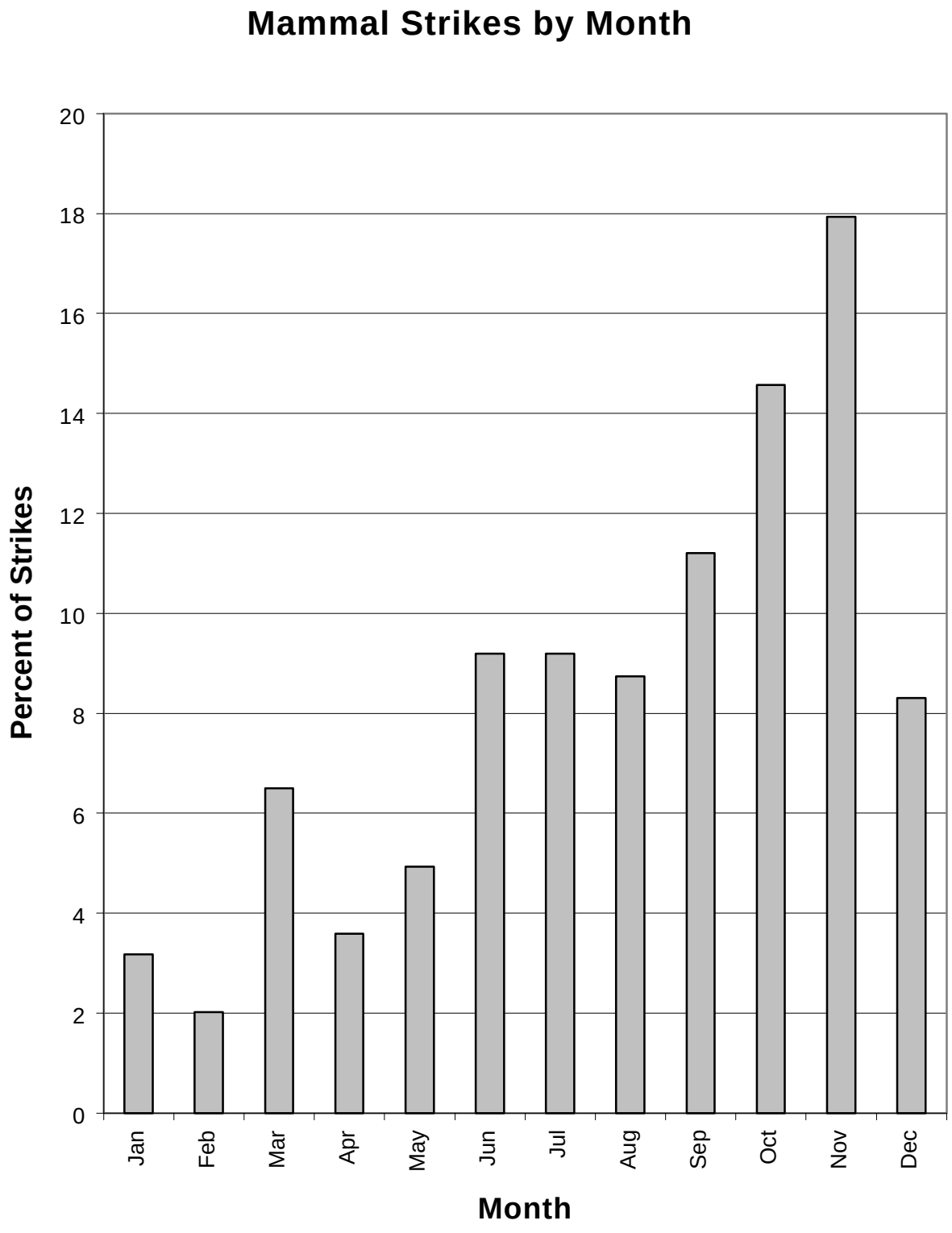

Figure 2. Percentage of reported mammal strikes to civil aircraft by month, USA, 1991-1997 (n = 446). See also Table 5.

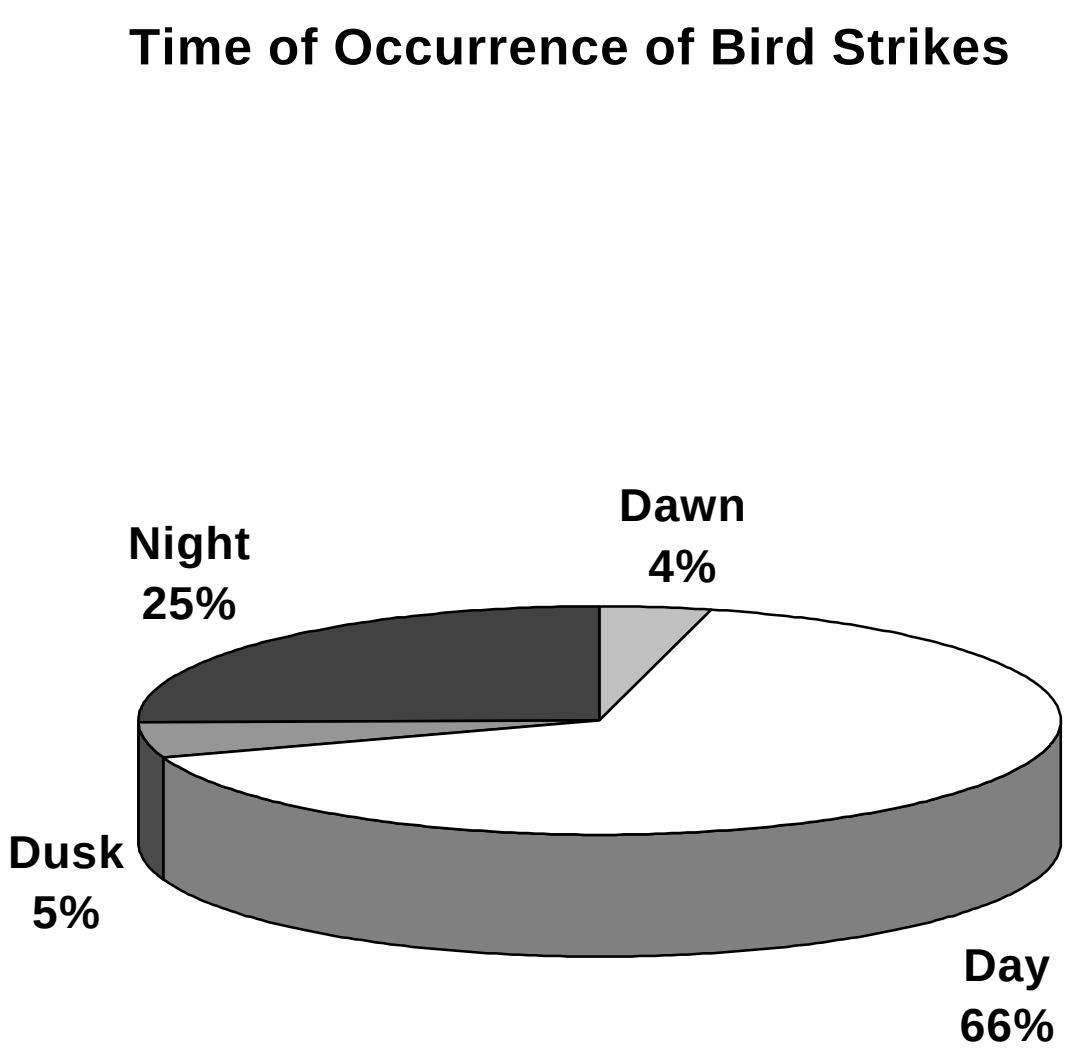

Figure 3A. Mean percentage of known time of occurrence for reported bird strikes to civil aircraft, USA, 1991-1997 (n = 2,215). See also Table 6.

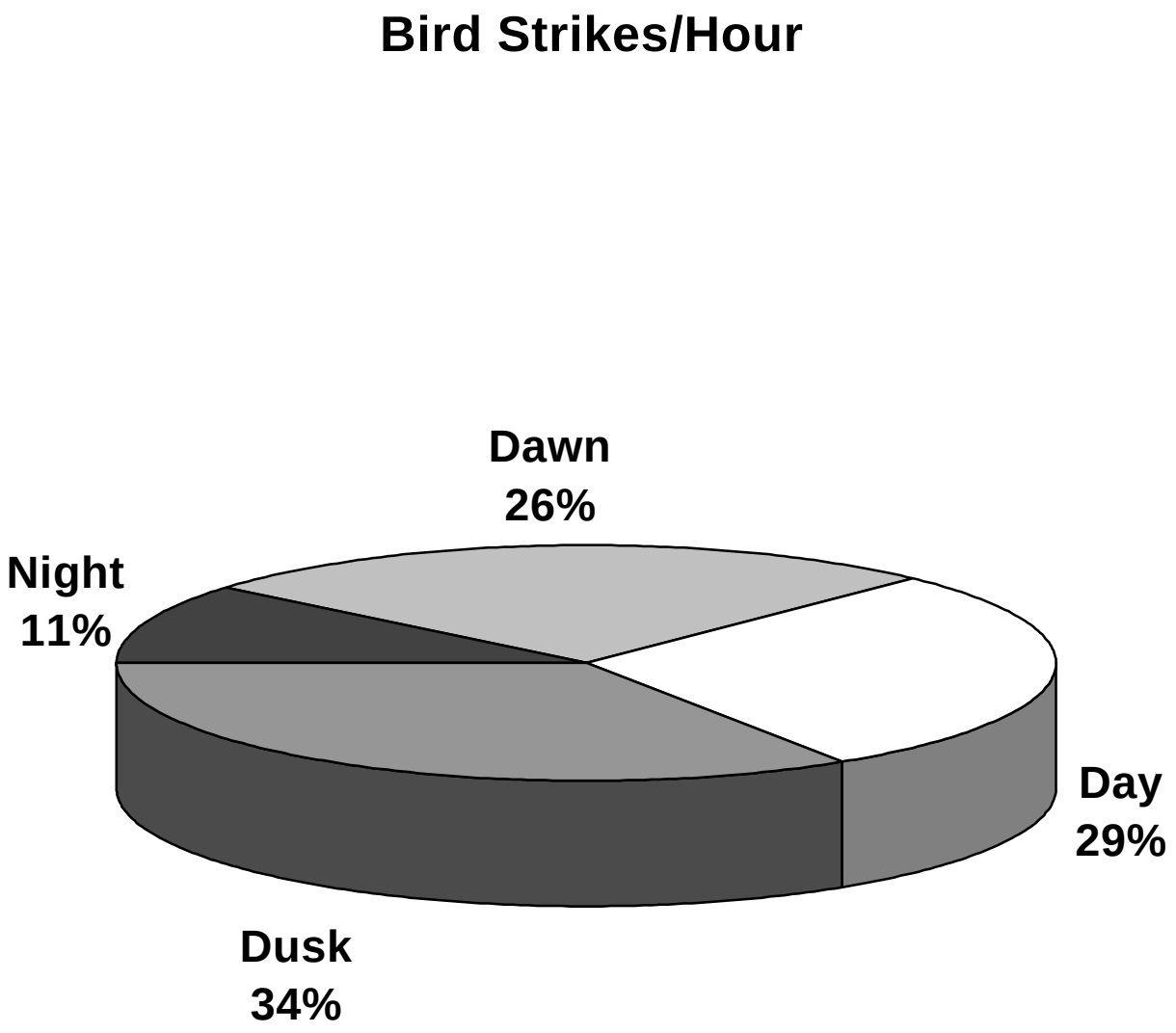

Figure 3B. Mean percentage of bird strikes/hour by known time of day to civil aircraft, USA, 1991-1997. (Strikes/hour were calculated using an average day and night length of 11.25 hours and an average dawn and dusk length of 0.75 hours each.)

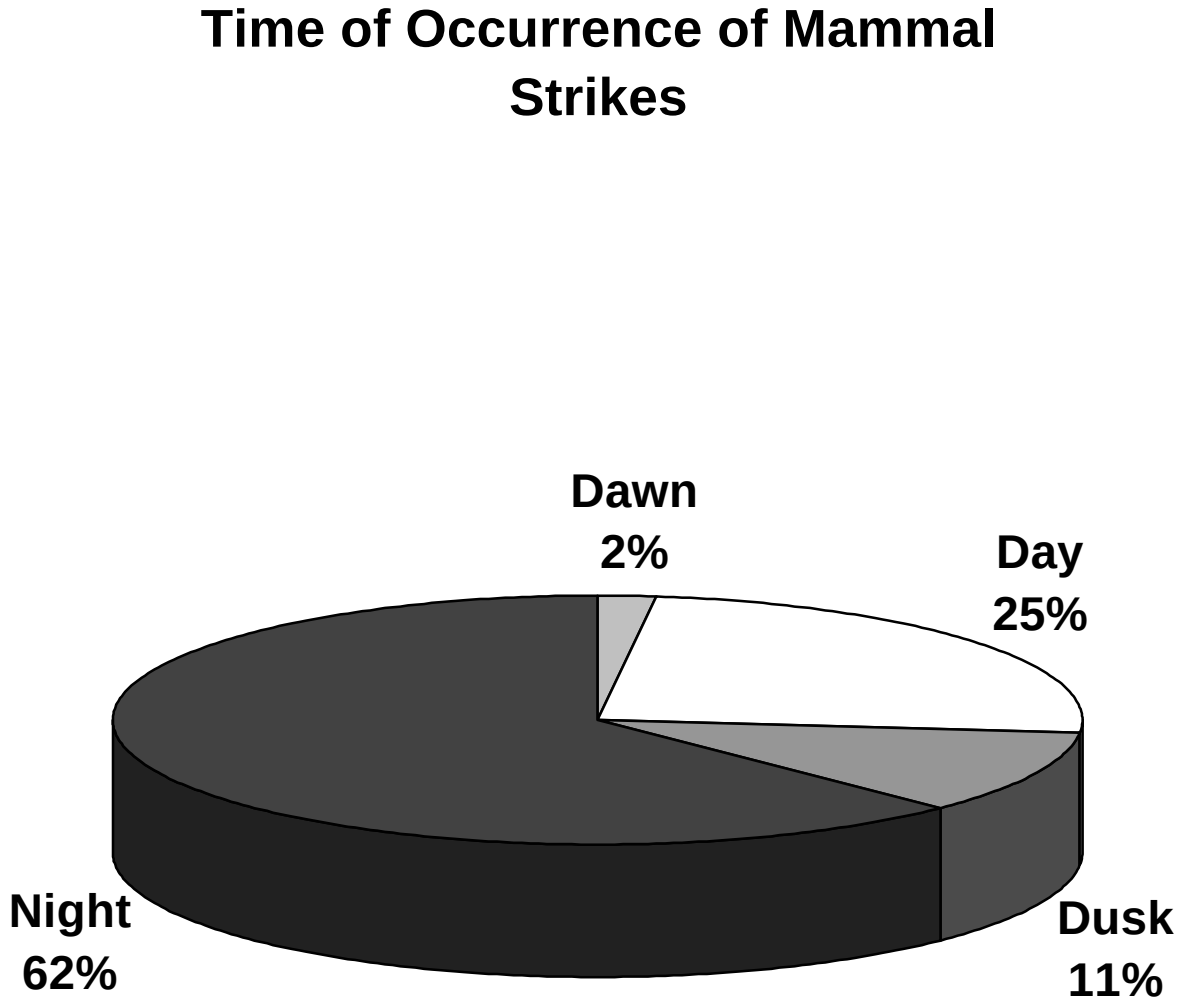

Figure 4A. Mean percentage of known time of occurrence for reported mammal strikes to civil aircraft, USA, 1991-1997 (n = 396). See also Table 6.

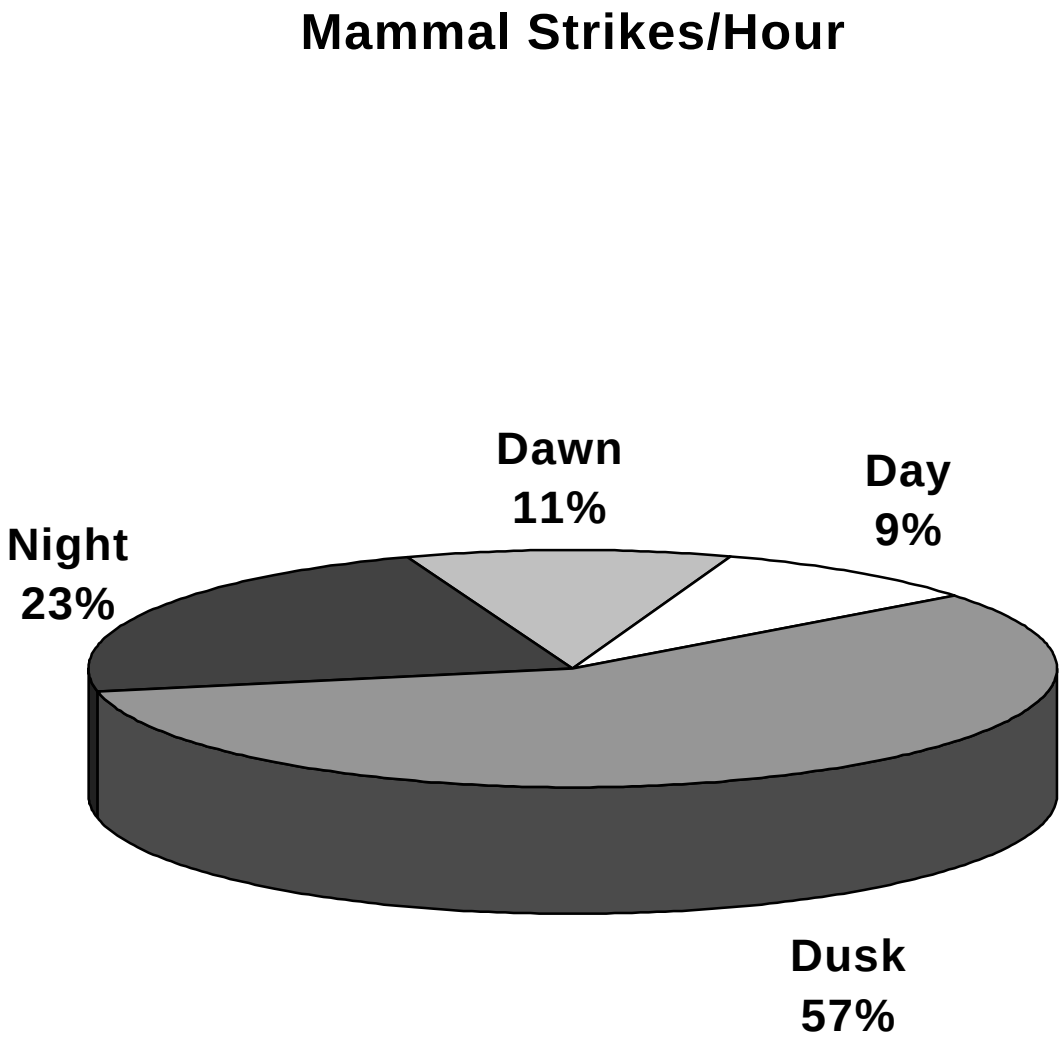

Figure 4B. Mean percentage of bird strikes/hour by known time of day to civil aircraft, USA, 1991-1997. (Strikes/hour were calculated using an average day and night length of 11.25 hours and an average dawn and dusk length of 0.75 hours each.)

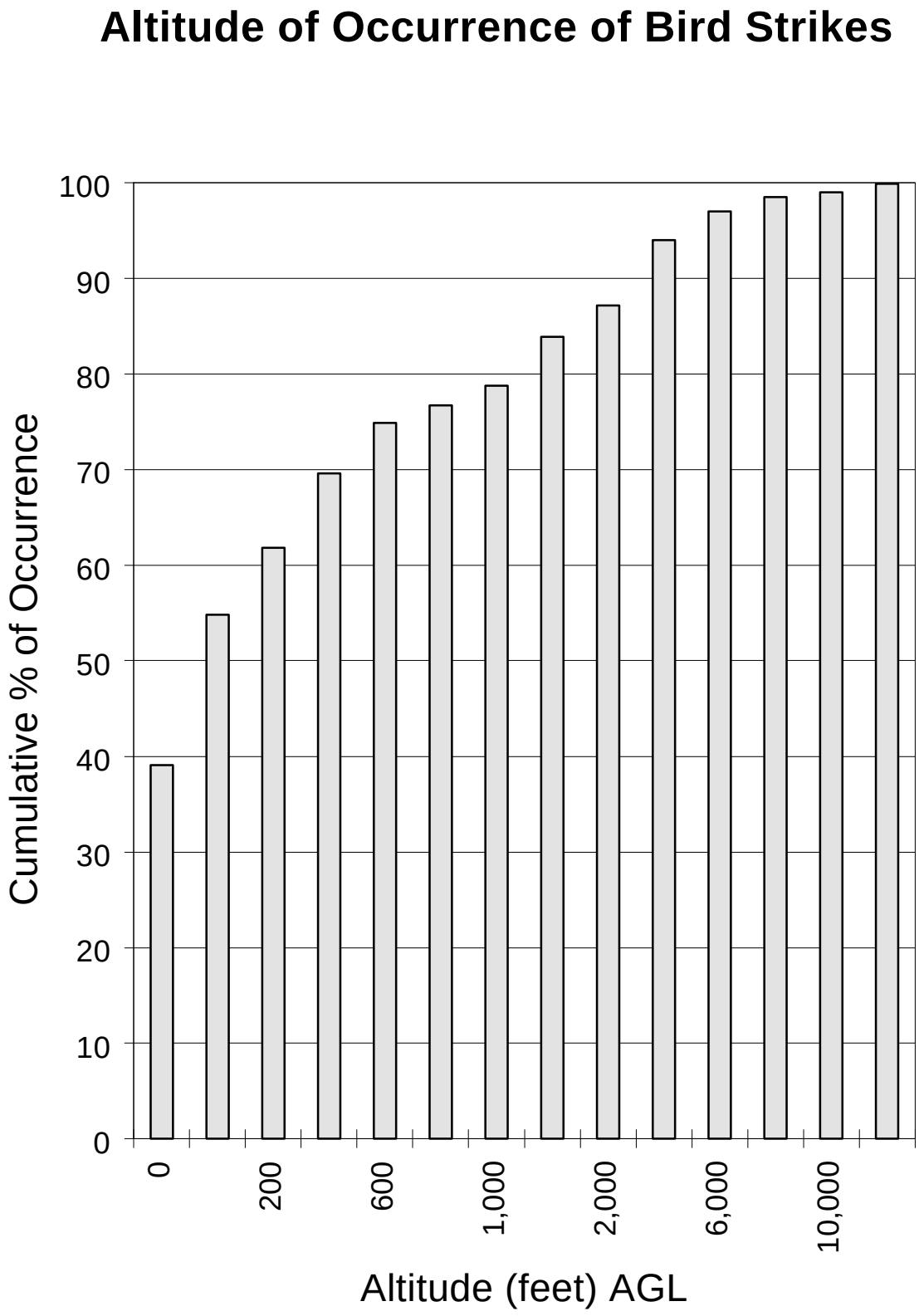

Figure 5. Cumulative percentage of reported strikes to civil aircraft by altitude (feet) above ground level (AGL), USA, 1991-1997 (n = 13,676). See also Table 8.